# Crawling Valley Reservoir Fall Walleye Index Netting Survey 2010

*Fisheries Management*

February, 2011

# Crawling Valley Reservoir Fall Walleye (*Sander vitreus*) Index Netting Survey, 2010

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February, 2011
Fisheries Management Division Technical Report

Government of Alberta ■
Sustainable Resource Development

## PERMISSION TO QUOTE

## ABSTRACT

The 2010 FWIN survey of Crawling Valley Reservoir was conducted from September 20 to 22, 2010. Objectives for this study included estimation of catch per unit effort and a variety of population dynamics (including age, growth rate, and reproductive status) in order to monitor the effects of management and to ensure the sustainability and stability of the Walleye population. A total of 285 Walleye were caught in 2010, representing an average catch per unit effort of 25.6 Walleye/100m$^2$/24h (95% CI: 17.8 – 33.9 Walleye/100m$^2$/24h). Fork length for this species was 391 mm on average (ranging from 90 mm to 650 mm). Walleye in Crawling Valley Reservoir reached 500 mm in total length by 6 years of age in 2010. The average age for this species was 6.3 years. While no individual year classes predominated the sample, fish aged 12 and 13 comprised 23.7% of the catch, while the 2003, 2007, and 2010 year classes each totalled roughly 11% of the CUE. Male Walleye were almost completely mature at the age of 6, and completely mature by 7. Female Walleye were mostly mature by the age of eight, with some individuals remaining immature until the age of 14. A Gonadosomatic Index of 1.5% distinguished mature spawning females from immature females. The growth observed for this species was rapid, but normal for Walleye in southern Alberta. Based on these characteristics the Walleye population in Crawling Valley Reservoir in 2010 can be classified as vulnerable.

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# 1.0 INTRODUCION

The popularity of Walleye (*Sander vitreus*) as a sport fish has led to the decline and collapse of several populations in Alberta as a result of overharvest. Historically, management for this species was conducted provincially, which proved ineffective at protecting Walleye populations in locations receiving high amounts of angling pressure. In response, Alberta Sustainable Resource Development established *Alberta's Walleye Management and Recovery Plan* (Berry, 1995). Under this plan individual populations are assessed and classified as trophy, stable, vulnerable, or collapsed. Management is then conducted with the goal of maintaining or improving the status of individual populations.

Crawling Valley Reservoir was stocked with Walleye between 1990 and 1992 with the goal of establishing a self-sustaining population. Follow-up surveys indicated that the population succeeded in establishing itself, and that natural reproduction was occurring. Crawling Valley Reservoir has subsequently become a popular Walleye angling destination. Crawling Valley Reservoir is situated near a variety of large and small population centers (most notably Calgary) and receives considerable amounts of angling pressure. In order to establish and conserve Walleye populations, regulations have always specified catch and release at Crawling Valley Reservoir. An additional night time closure (i.e. no angling permitted from sunset to sunrise) was put into effect in 2004 to reduce illegal harvest.

A Fall Walleye Index Netting (FWIN) survey was conducted in 2010 at Crawling Valley Reservoir to assess levels of natural recruitment and overall population status. This follows up on earlier FWIN studies conducted in 2004 and 2008.

## 2.0 METHODS

### 2.1 Study Area

Crawling Valley Reservoir (Townships 46 and 47, and Ranges 17 and 18 West of the 4th Meridian) is located approximately 140 km east of the City of Calgary and roughly 7 km northeast of the town of Bassano, Alberta (Figure 1). This mildly eutrophic reservoir is situated straddling the mixed grass and short grass ecoregions (Mitchell and Prepas, 1990). Large areas of original grassland still exist around the reservoir, which is owned and operated by the Eastern Irrigation District (EID) and some privately owned farmland exists along the northwestern part of the reservoir. Major land use in the area is low intensity farming (both dryland and irrigated), including livestock grazing and agriculture. There are also several active gas wells in the area.

Crawling Valley Reservoir was created as an offstream storage reservoir for irrigation in 1985, incorporating Barkenhouse Lake (which existed at the same location). Water enters the reservoir at the southwest corner from the Bow River via the EID North Branch Canal, and empties at the southeast corner. Primary access to the reservoir is also located in the southwest corner at the Crawling Valley Reservoir Campground, which is situated by the main dam and the inlet canal. Additional access points scattered along the shoreline can be reached by oil and gas roads, but these are limited to small craft (launched by hand), or shore anglers. The reservoir is a flooded valley, and is long and sinuous in shape with a very complex shoreline (approximately 150 km perimeter). At Full Supply, Crawling Valley Reservoir has a surface area of 2315 ha, a maximum length of 15.5 km, and a maximum width of 4.9 km. The reservoir is generally shallow, with a gently sloping bottom. Mean depth is 5.7m, and the maximum depth is 16.8 m (Alberta Sustainable Resource Development 2004).

The campground offers a variety of facilities including 120 campsites, showers, restrooms, a day use area with picnic tables, tap water, two boat launches, and a marina.

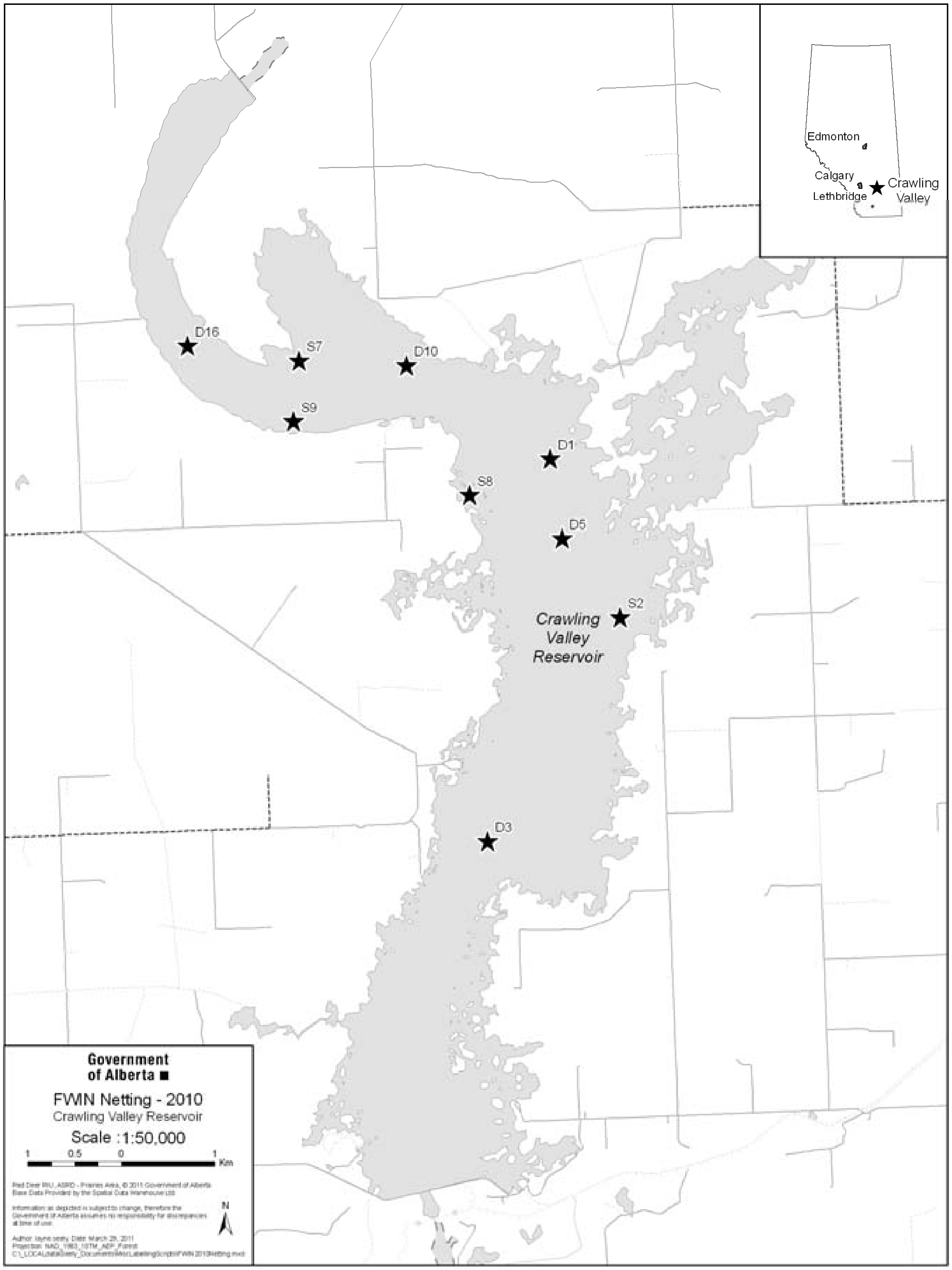


Figure 1. Map of Crawling Valley Reservoir including 2010 netting sites and location in Alberta.

### 2.2 Survey Methods

The FWIN protocol developed by the Ontario Ministry of Natural Resources in 2000 was employed to survey Crawling Valley Reservoir in 2010 (Morgan 2000). According to this method, nets are composed of eight ascending panels of different mesh sizes (25 mm, 38 mm, 51mm, 64mm, 76mm, 102mm, 127mm, and 152mm, respectively) without spacers. A standard FWIN net measures 61.0m long by 1.8 m deep, spanning an area of 109.8m$^2$.

Nets were placed by assigning random locations within depth and distance strata according to the methodology described in Watkins (2005). While this methodology allows for the selection of an alternate location if an inappropriate spot is initially chosen (too shallow, heavily vegetated, or a very steep bottom gradient), all of the randomly generated locations were used in 2010. Four (4) nets were set in the shallow stratum, and 6 in the deep stratum, for a total of 10 nets set for 2010 (Figure 1). In accordance with protocol, nets were set perpendicular to shore for approximately 24 hours.

The catches for individual panels were bagged separately and identified with grid location numbers and mesh sizes. Seven species were sampled in 2010, including Walleye, Northern Pike, Lake Whitefish, Yellow Perch, Cisco, Burbot, and White Sucker. Sport species were visually examined to catalogue hooking injuries and illnesses and subjectively assess general physical condition (normal weight versus exceptionally fat or thin individuals). Fork length (mm), total length (mm), and weight (g) were measured, and species specific aging structures were collected. Gender and maturity for Walleye were determined by examination of the gonads (which including measurement of the weight of female gonads in grams). If the gonads were assessed to be sufficiently developed for spawning during the following spring, fish were classified as mature. Non spawning females were identified by the absence of developing eggs despite the presence of mature gonadal development.

For some of the analysis and comparisons in this report a weighted CUE (catch per unit effort) was used. The weighted CUE is the number of fish caught per net per twenty-four hours. The weighted CUE is calculated using the formula:

$$Weighted\_CUE = \left( \frac{\left( \frac{Number\_of\_fishx24h}{Number\_of\_hours\_net\_was\_set} \right) x100m^2}{109.8m^2} \right)$$

Walleye ages were assigned by a modified methodology from that described in MacKay et al. (1990). The first annulus tightly surrounding the focus (indicating one year of age) was identified using the following formula:

$$1^{st} \text{ annulus} = \frac{rL\ (\text{age-0 } L)}{L}$$

where:

rL = radius length (distance from the center of the focus to the furthest edge)

Age-0 L = hypothesized length of age-0 Walleye at time sampled

L = length of the sampled Walleye

The von Bertalanffy growth equation was used to calculate growth parameters. The following equation was used:

$$L_t = L_\infty(1 - e^{-k\,(t-t_0)})$$

where:

$L_\infty$ = maximum theoretical length (fork length infinity) that can be obtained;

k = growth coefficient;

t = time of age in years;

$t_0$ = is the time in years when length would theoretically be equal to zero and;

e = exponent for natural logarithms.

$L_\infty$, $t_0$, and k were calculated using the Fishery Analysis and Simulation Tools ver. 2.1 (Slipke and Maceina 2001). The length-at-age data were fitted to the growth model by applying the equation independently to each sample.

All data were analysed and written using Microsoft Office 2000 Professional (9.0.7616 SP-3) (MSAccess, MSExcel, MSWord). The data set for this study is stored in the Alberta Sustainable Resource Development *Fisheries and Wildlife Management Information System* database (FWMIS).

3.0 RESULTS AND DISCUSSION

3.1 Water Temperatures and Netting Effort

The 2010 FWIN survey of Crawling Valley Reservoir was conducted between September 20, 2010 and September 22, 2010 (Appendix 1). Water temperatures ranged from 12 ºC to 13 ºC. A total of 10 nets were set in 2010; 4 in the shallow stratum and 6 in the deep stratum. The mean soak time was 24.0 hours (95%CI: 23.0 – 25.2 hours).

3.2 Catch Results

A total of 426 fish were caught in Crawling Valley Reservoir during the 2010 FWIN, representing 7 different species (Appendix 1). The average catch for all species was 38.5 fish/100m$^2$/24 h (95% CI: 29.1 – 48.1 fish/100m$^2$/24 h). Walleye were the most frequently caught fish (n=285, 66.9%), followed by Northern Pike (n=61, 14.3%), Cisco (n=41, 9.6%), White Sucker (n=18, 4.2%), Lake Whitefish (n=14, 3.3%), Yellow Perch (n=6, 1.4%) and Burbot (n=1, 0.2%). An average of 34.3 fish/100m$^2$/24 h (95%CI: 24.6 – 45.6 fish/100m$^2$/24 h) were captured in the shallow sets, while 41.2 fish/100m$^2$/24 h (95%CI: 27.1 – 52.3 fish/100m$^2$/24 h) were caught in the deep sets.

3.3 Walleye Catch Per Unit Effort

Walleye were caught in all mesh sizes in 2010 (Appendix 1). The highest catch occurred in the 76 mm mesh (n=61). An average of 18.6 Walleye/100m$^2$/24 h (95% CI: 11.5 – 27.0 Walleye/100m$^2$/24 h) were caught in the shallow sets, while an average of 30.3 Walleye/100m$^2$/24 h (95% CI: 19.8 – 41.4 Walleye/100m$^2$/24 h) were caught in the deep sets. The overall weighted catch per unit effort for Walleye from Crawling Valley Reservoir was therefore 25.6 Walleye/100m$^2$/24 h (95% CI: 17.8 – 33.9 Walleye/100m$^2$/24 h). The catch was normally distributed (Figure 2).

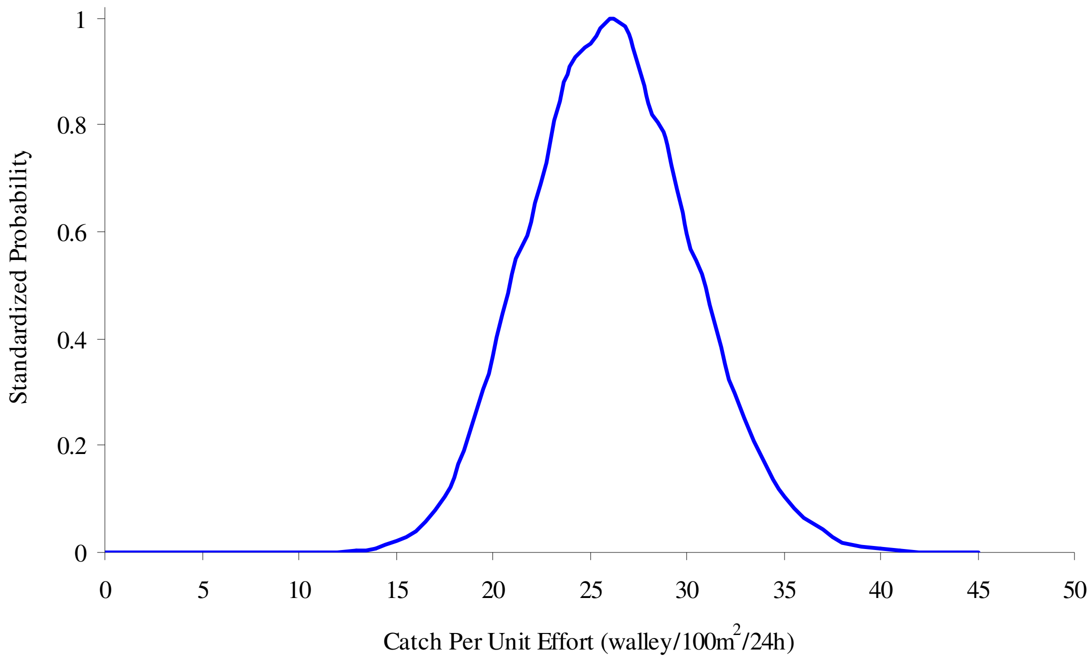


Figure 2. Walleye catch frequency distribution, Crawling Valley Reservoir 2010, standardized probability function of the number of Walleye caught. (2010 MLE (maximum likelihood estimation) = 25.6 Walleye/100m$^2$/24 h (95% CI: 17.8 – 33.9 Walleye/100m$^2$/24 h).)

### 3.4 Catch Rate Comparison

The catch rate observed for Walleye from Crawling Valley Reservoir in 2010 was average for other locations in Alberta, and high relative to water bodies in the southern portion of the province. Comparatively, the CUE for Crawling Valley in 2010 was higher than in 2008, and similar to that recorded in 2004.

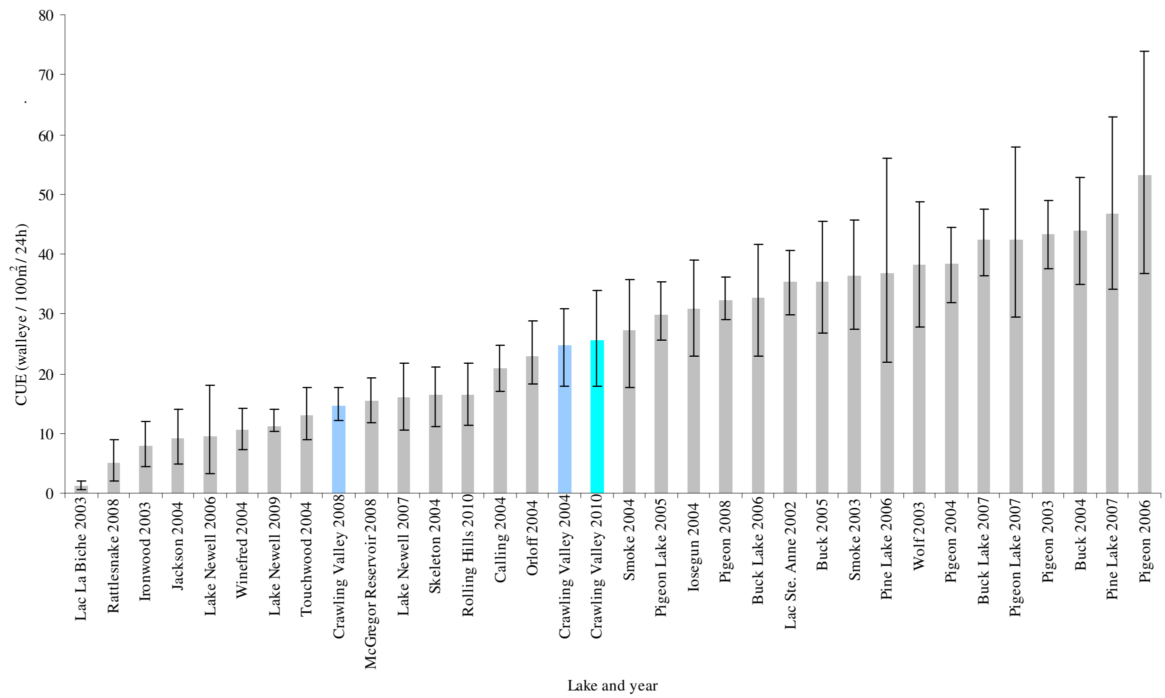


Figure 3. FWIN catches from 34 Alberta lakes from 2002-2010. Error bars depict 95% confidence intervals

3.5 Fork Length Frequency Distribution

In 2010 the fork length frequency distribution for Walleye ranged from 90 mm to 650 mm (n=270). Fish 430 – 510 mm in length predominated in the sample (Figure 4). The overall CUE for this size class was 10.7 Walleye/100m$^2$/24h (41.8% of the sample). In general the Walleye sampled from Crawling Valley Reservoir in 2010 were representative of a broad range of sizes.

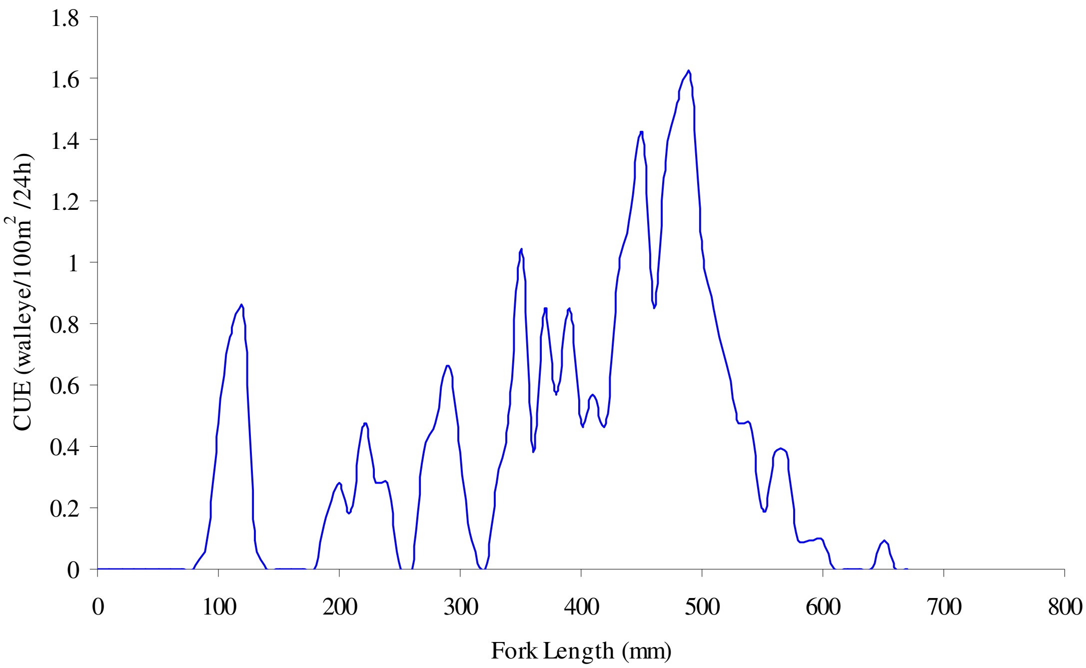


Figure 4. Walleye Fork Length Frequency Distribution, Crawling Valley Reservoir 2010 (mean fork length = 391 mm).

### 3.6 Age Class Frequency Distribution

Walleye caught during the 2010 Crawling Valley FWIN ranged from 0 to 19 years in age (Figure 5). While no individual year classes predominated in the sample, fish aged 12 and 13 comprised 23.7% of the catch, while the 2003, 2007, and 2010 year classes each totalled roughly 11% of the CUE (i.e. age 7 (10.8%), age 3 (11.1%). And age 0 (11.9%)). The 2003 and 1998 year classes (representing fish currently age 7 and 12 years) were prominent in the 2008 FWIN sample (Winkel, 2010). The Walleye population in Crawling Valley Reservoir is primarily supported by three age classes in 2010.

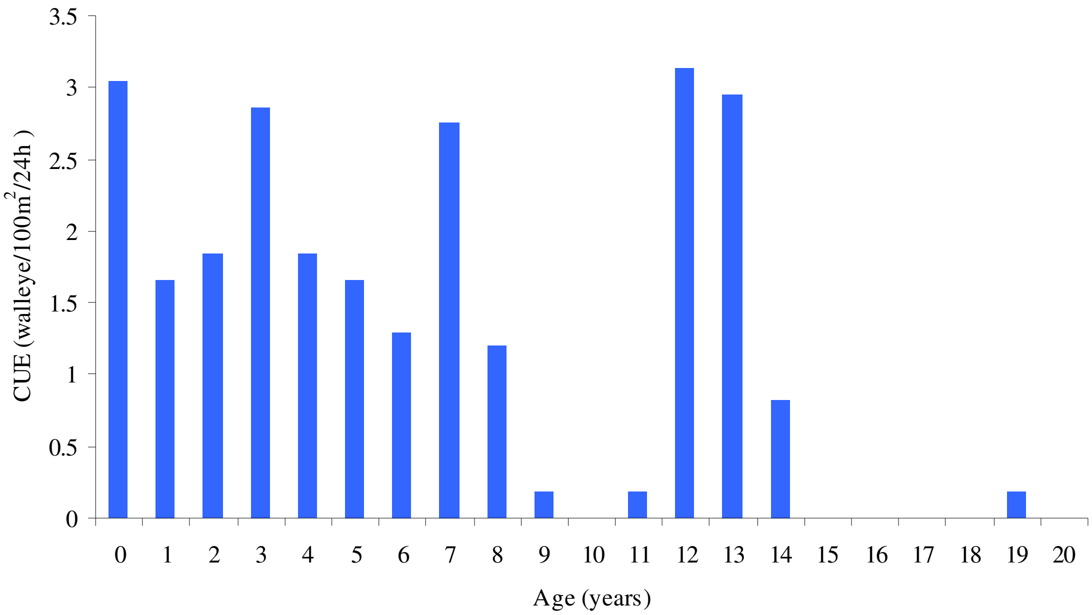


Figure 5. Walleye age-class frequency distribution, Crawling Valley Reservoir 2010.

### 3.7 Age Class Stability

The age class structure of the Walleye population had a wide distribution in 2010, ranging from 0 to 19 years, with a mean age of 6.3 years. An abundance of young of the year fish were captured in 2010 (n=33), while only 2 fish of the oldest age class (19 years) were caught. The presence of fish in all age classes under 5 years in the sample is indicative that recruitment is occurring at Crawling Valley Reservoir. The absence of 10 year old fish in the 2010 FWIN is difficult to explain given the moderately strong representation of this age class in the 2008 FWIN. According to the parameters laid out in the stock classification matrix, average age, age at maturity, and distribution of age classes for Walleye in 2010 are indicative of a stable population (Berry, 1995) (Table 1).

Table 1. Criteria for classifying status of Walleye fisheries, modified for FWIN analysis (from Sullivan 2003).

| STATUS OF STOCK | TROPHY | STABLE | VULNERABLE | COLLAPSED |
|---|---|---|---|---|
| **Age-class Distribution** | Wide<br>8 or more age classes<br>mean age >9 | Wide<br>8 or more age classes<br>mean age = 6-9 | Narrow<br>1-3 age classes<br>mean age = 4 - 6<br>few old (>10 years)<br>fish | Wide or Narrow<br>Mean age = 6 - 10 |
| Crawling Valley Reservoir 2010 | | **15 age-classes**<br>**mean age 6.3** | | |
| **Age-class Stability** | Very Stable<br>1 - 2 age classes<br>out of smooth catch curve | Relatively Stable<br>2 - 3 age classes<br>out of smooth catch curve | Unstable<br>1 - 3 age classes support fishery | Stable or Unstable<br>Recruitment failures |
| Crawling Valley Reservoir 2010 | | | **3 age-classes** | |
| **Age-At-Maturity** | Females 10 - 20<br>Males 10 - 16 | Females 8 - 10<br>Males 7 - 9 | Females 7 - 8<br>Males 5 - 7 | Females 4 - 7<br>Males 3 - 6<br>Ages will vary with age class distribution |
| Crawling Valley Reservoir 2008 | | **Females at 10.1**<br>**Males at 9.3** | | |
| **Length-at-age** | Very slow<br>50 cm (FL) in<br>12 - 15 years | Slow<br>50 cm (FL) in<br>9 - 12 years | Moderate<br>50 cm (FL) in<br>7 - 9 years | Fast<br>50 cm (FL) in<br>4 - 7 years |
| Crawling Valley Reservoir 2010 | | | | **50 cm FL**<br>**in 7 years** |
| **Catch Rate**<br>**FWIN** | | High >30<br>Walleye / net | Moderate 5 - 25<br>Walleye / net | Low <5<br>Walleye / net |
| Crawling Valley Reservoir 2010 | | | 25.6 Walleye/net | |

### 3.8 Age at Maturity

The overall sex ratio was 1.3 females : 1 male Walleye at Crawling Valley Reservoir in 2010. While 97.3% of males were mature by age 6, all were mature by age 7 (Figure 6). In contrast, the majority of females were mature by age 8, with some individuals remaining immature until 14 years of age (Figure 7). This falls within the stable category for Walleye populations in Alberta.

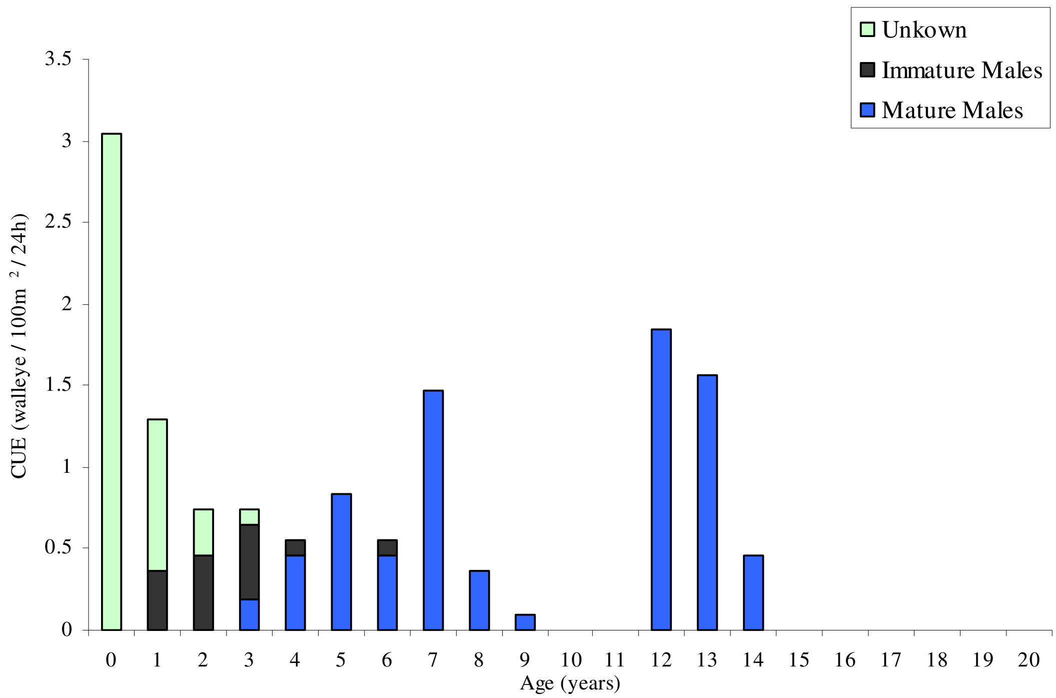


Figure 6. Age-at-maturity of male Walleye, Crawling Valley Reservoir 2010

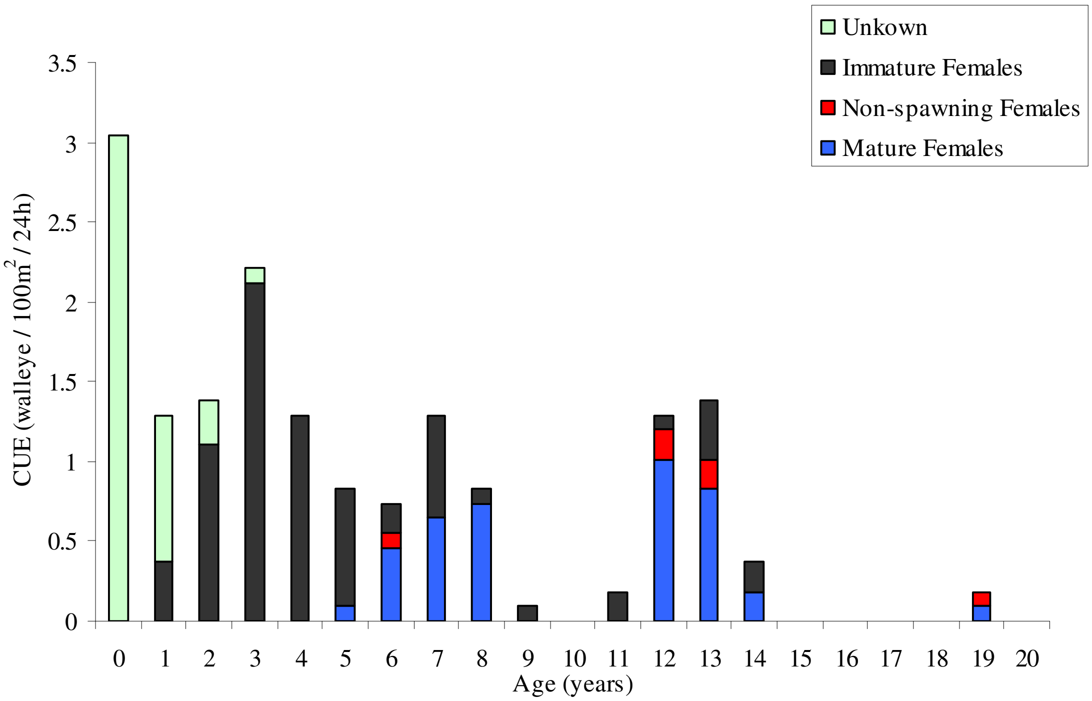


Figure 7. Age-at-maturity of female Walleye, Crawling Valley Reservoir 2010

### 3.9 Length at Age

Walleye captured during the 2010 FWIN survey at Crawling Valley Reservoir exhibited a normal growth pattern for this species, with immature fish (male, female, and unknown) growing at a similar rate. As they mature, female fish grew progressively faster than male Walleye. Both genders reached 500 mm in fork length by 7 years of age.

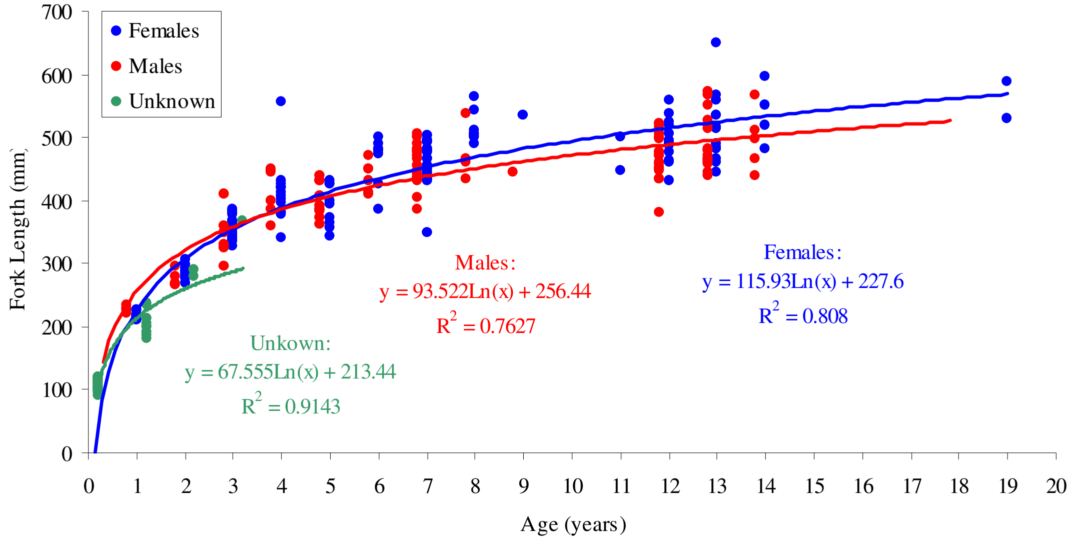


Figure 8. Length-at-age (logarithmic line of best fit) of male, female, and unknown Walleye, Crawling Valley Reservoir 2010.

There were 85 fish equal to or greater than 500 mm in total length caught in 2010, with a CUE of 8.1 Walleye/100m$^2$/24h (Figure 9). The total length of these fish ranged from 500 mm to 674 mm, with ages that ranged from 4 to 19 years.

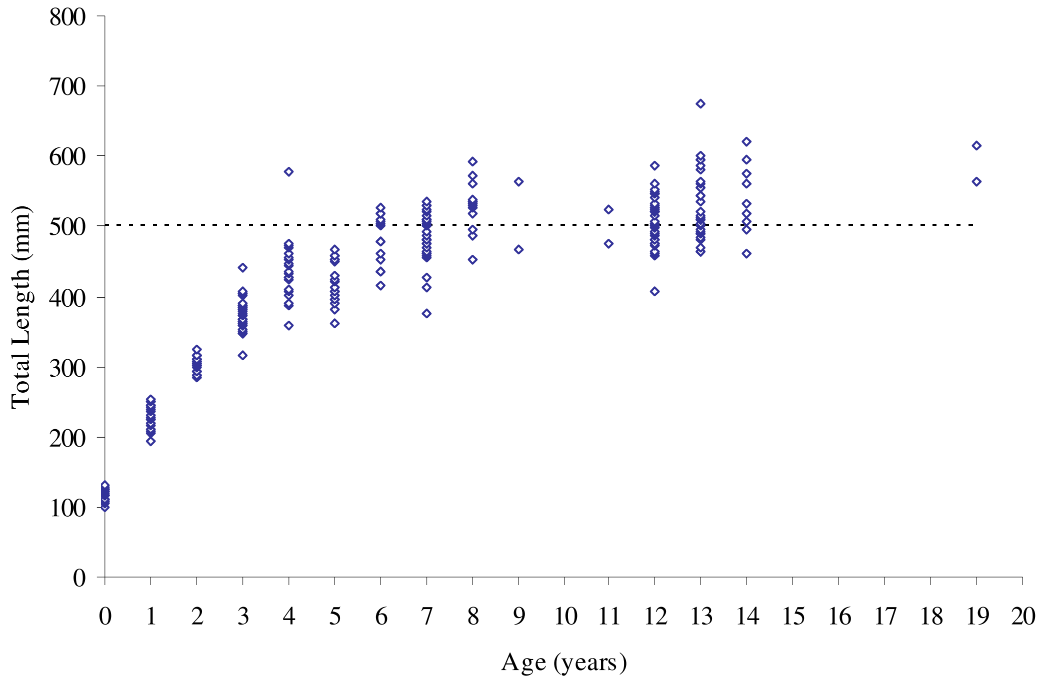


Figure 9. Walleye length-at-age for Crawling Valley Reservoir, 2010.

### 3.10 Length at Weight

The mean weight for Walleye caught in 2010 was 843 g (n=269). Weights ranged from 8 g to 2975 g (Figure 10). The increase in weight relative to length observed for fish from the 2010 FWIN at Crawling Valley Reservoir corresponds to the expected ratio for healthy fish populations.

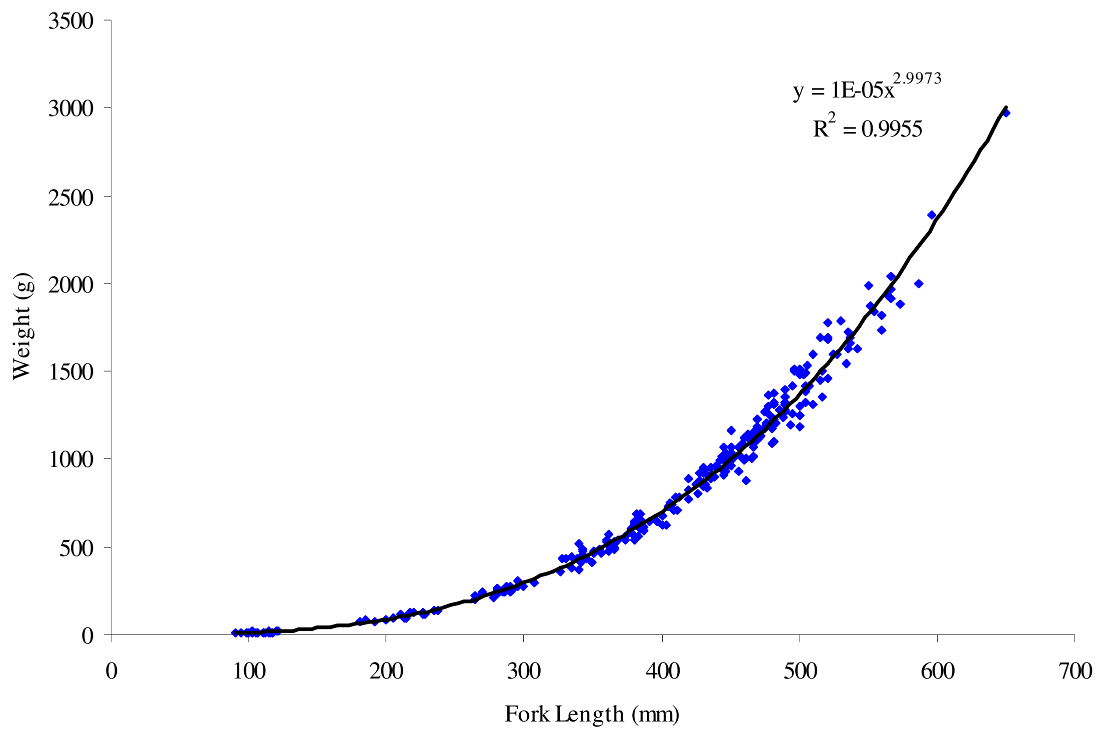


Figure 10. Walleye length-at-weight, Crawling Valley Reservoir 2010 (Average weight = 843 g, min = 8 g, max = 2975 g, n = 269).

### 3.11 Gonadosomatic Index

The gonadosomatic index (GSI) is the ratio of gonad weight to body weight for female Walleye. Based on the increase in relative size of gonads in mature fish, as well as presence of developing eggs in the gonad (which can be confirmed visually) this measure is used to establish the length and age at which females, in a given population, spawn. In 2010 females with a GSI greater than 1.5% were mature at Crawling Valley Reservoir.

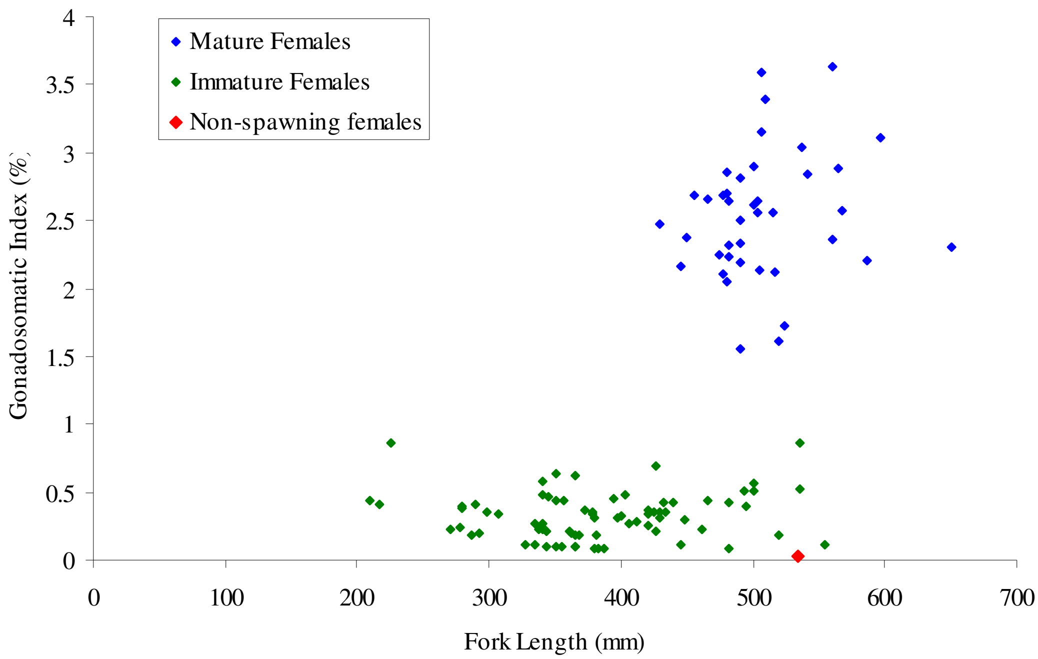


Figure 11. Gonadosomatic Index (%) for female Walleye, Crawling Valley Reservoir 2010.

### 3.12 Von Bertalanffy Growth Equation

Growth in fish is generally asymptotic in nature, with length increasing most rapidly in early life, and decreasing over time as age and size maxima are attained. Various growth parameters can be calculated by plotting growth relative to age and performing regression analyses (using FAST). The growth rate (k) for Walleye from Crawling Valley Reservoir was 0.285 in 2010, while the maximum (or asymptotic) fork length ($L\infty$) was 526 mm (Figure 12).

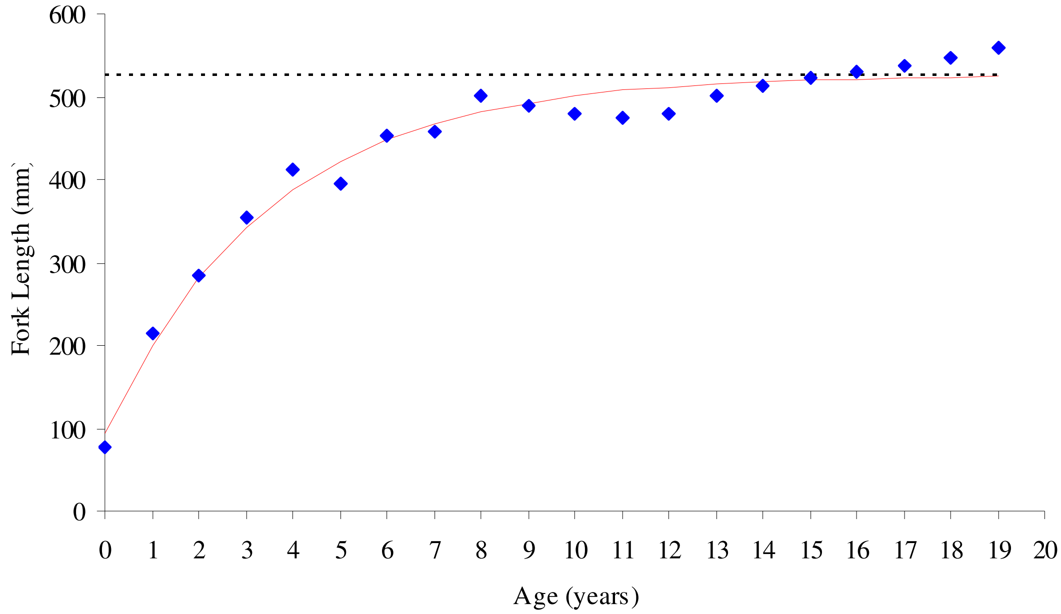


Figure 12. Von Bertalanffy growth curve and parameters fitted to observed fork length-at-age data for Crawling Valley Reservoir, 2010. (k = 0.285, $t_0$ = -0.685, $L_\infty$ = 526 mm FL)

4.0 SUMMARY

Walleye reproduction and the recruitment of young fish is successful at Crawling Valley Reservoir, indicated by the presence of all year classes under 5 in the 2010 sample. Fish between the ages of nine and eleven years were present in relatively low numbers, with peaks observed for Walleye aged 12 and 13. As a result, only 3 age classes (fish aged 7, 12, and 13) largely support the Walleye population at Crawling Valley Reservoir.

The rapid growth and lack of older fish in the population are characteristic of unstable Walleye populations. With appropriate management this situation could stabilize such that a wider diversity of Walleye would be found at Crawling Valley Reservoir, with multiple age classes supporting the population.

The catch rate observed for Crawling Valley Reservoir was average for other locations in Alberta, and high relative to other water bodies in the southern part of the province. According to the criteria laid out in the ASRD Walleye Management and Recovery Plan, the Walleye population in Crawling Valley Reservoir would be classified as vulnerable in 2010 (Berry, 1995).

While a wide range of ages were observed in 2010, the average Walleye age was low, characteristic of a stable population. The population is, however, only supported by 3 age classes, which is indicative of a vulnerable population. Age-at-maturity was atypical in 2010. While some females matured as early as five years of age, immature fish were observed as late as 14 years, and a non-spawning female was observed at 19 years of age. In addition, a subset of apparently mature female Walleye were observed to exhibit abnormal gonad development. As a result, while age-at-maturity falls within the "stable" category of the Stock Assessment Matrix a limited or truncated number of actually reproducing individuals could potentially impact future population growth.

Length-at-age fell within the "collapsed" category of the Stock Classification Matrix. This could be characteristic for Walleye growth in the relatively warmer, highly productive waters in southern Alberta. The catch rate observed in 2010 was moderate, indicative of a vulnerable population. Since these diagnostic criteria were so diverse the Walleye population in Crawling Valley Reservoir was classified as vulnerable in 2010.

5.0 LITERATURE CITED

Berry D.K. 1995. Alberta's Walleye Management and Recovery Plan. Alberta Environment Protection, Natural Resources Service. Number T/310. 32 pp.

Campana S.E. 2001. Accuracy, precision and quality control in age determination, including review of the use and abuse of age validation methods. Journal of Fish Biology 59, 197-242.

Casselman J. M. 1995. Otolith techniques for identifying and discriminating between pond-cultured and indigenous Walleye *Stizostedion vitreum* from the natural environment. Ontario Ministry of Natural Resources, Glenora Fisheries Station, Glenora.

Mackay, W.C., G.R. Ash, and H.J. Norris (eds.). 1990. Fish ageing methods for Alberta. R.L. & L. Environmental Services Ltd. In assoc. with Alberta Fish and Wildlife Division and University of Alberta, Edmonton. 113 pp.

Mitchell, P. and E. Prepas. 1990. Atlas of Alberta Lakes. University of Alberta Press, Edmonton. 675 pp.

Morgan G.E. 2000. Manual of Instructions, Fall Walleye Index Netting (FWIN). Ontario Ministry of Natural Resources. Fish and Wildlife Branch. 37 pp.

Patterson B. 2004. Assessment of the summer sport fishery for Walleye and northern pike at Pigeon Lake, 2003. Produced by Alberta Conservation Association Edmonton, Alberta, Canada. 55p

Slipke, J. and M. Maceina. 2001. Fishery analyses and simulations tools (FAST), version 2.1. Auburn University, Department of Fisheries and Allied Aquacultures, Auburn, Alabama, USA. 156pp.

Sullivan M.G. 2003. Active management of Walleye fisheries in Alberta: dilemmas of managing recovering fisheries. North America Journal of Fisheries Management 23(4): in press

Watkins O. 2005. Pigeon Lake Fall Walleye, *Sander vitreus*, Index Netting Survey, 2004. Alberta Sustainable Resource Development, Fish and Wildlife Division. Data Report. pp. 46

Winkel, L. 2009. Crawling Valley Reservoir Fall Walleye (*Sander vitreus*) Index Netting Survey, 2008. Alberta Sustainable Resource Development Fisheries Management Division Technical Report. pp. 32.

# 6.0 APPENDICES

## 6.1 Catch Composition for FWIN nets, Crawling Valley Reservoir 2010

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | WALL | NRPK | CISC | Species WHSC | LKWH | YLPR | BURB | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 21 | 8 | 1 | 2 | 2 | 5 | 0 | 39 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 57 | 9 | 3 | 1 | 0 | 1 | 0 | 71 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 45 | 6 | 9 | 1 | 2 | 0 | 0 | 63 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 17 | 10 | 2 | 0 | 3 | 0 | 0 | 32 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 33 | 2 | 4 | 0 | 0 | 0 | 1 | 40 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 41 | 4 | 13 | 1 | 0 | 0 | 0 | 59 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 21 | 4 | 7 | 1 | 0 | 0 | 0 | 33 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 32 | 7 | 1 | 7 | 6 | 0 | 0 | 53 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 9 | 7 | 0 | 5 | 1 | 0 | 0 | 22 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 9 | 4 | 1 | 0 | 0 | 0 | 0 | 14 |
| Total | | | | 285 | 61 | 41 | 18 | 14 | 6 | 1 | 426 |
| Average | | | 24.0 | | | | | | | | |

### 6.1.1 Catch composition from shallow sets, Crawling Valley Reservoir 2010

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | WALL | NRPK | CISC | Species WHSC | LKWH | YLPR | BURB | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 21 | 8 | 1 | 2 | 2 | 5 | 0 | 39 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 17 | 10 | 2 | 0 | 3 | 0 | 0 | 32 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 32 | 7 | 1 | 7 | 6 | 0 | 0 | 53 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 9 | 7 | 0 | 5 | 1 | 0 | 0 | 22 |
| Total | | | | 79 | 32 | 4 | 14 | 12 | 5 | 0 | 146 |
| Average | | | 23.4 | | | | | | | | |

### 6.1.2 Catch composition from deep sets, Crawling Valley Reservoir 2010

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | WALL | NRPK | CISC | Species WHSC | LKWH | YLPR | BURB | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 57 | 9 | 3 | 1 | 0 | 1 | 0 | 71 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 45 | 6 | 9 | 1 | 2 | 0 | 0 | 63 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 33 | 2 | 4 | 0 | 0 | 0 | 1 | 40 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 41 | 4 | 13 | 1 | 0 | 0 | 0 | 59 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 21 | 4 | 7 | 1 | 0 | 0 | 0 | 33 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 9 | 4 | 1 | 0 | 0 | 0 | 0 | 14 |
| Total | | | | 206 | 29 | 37 | 4 | 2 | 1 | 1 | 280 |
| Average | | | 24.6 | | | | | | | | |

## 6.2 Walleye, Lake Whitefish, and Northern Pike catches by mesh size, Crawling Valley Reservoir 2010

WALL

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 0 | 0 | 1 | 3 | 6 | 8 | 3 | 0 | 21 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 14 | 2 | 10 | 11 | 13 | 7 | 0 | 0 | 57 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 10 | 6 | 5 | 7 | 9 | 3 | 3 | 2 | 45 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 2 | 3 | 6 | 4 | 2 | 0 | 17 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 11 | 2 | 0 | 5 | 5 | 6 | 4 | 0 | 33 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 7 | 4 | 8 | 10 | 7 | 4 | 1 | 0 | 41 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 3 | 1 | 4 | 6 | 5 | 2 | 0 | 0 | 21 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 4 | 2 | 1 | 4 | 9 | 7 | 5 | 0 | 32 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 1 | 1 | 0 | 0 | 0 | 5 | 2 | 0 | 9 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 1 | 0 | 2 | 3 | 1 | 2 | 0 | 0 | 9 |
| Total | | | | 51 | 18 | 33 | 52 | 61 | 48 | 20 | 2 | 285 |

LKWH

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 2 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 3 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 3 | 6 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | | 0 | 1 | 0 | 2 | 3 | 3 | 1 | 4 | 14 |

NRPK

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 1 | 1 | 1 | 1 | 3 | 1 | 0 | 0 | 8 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 1 | 2 | 0 | 0 | 3 | 3 | 0 | 0 | 9 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 0 | 6 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 1 | 3 | 3 | 3 | 0 | 0 | 10 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 2 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 4 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 4 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 0 | 1 | 2 | 2 | 2 | 0 | 0 | 0 | 7 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 1 | 1 | 1 | 3 | 1 | 0 | 0 | 7 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 4 |
| Total | | | | 5 | 6 | 7 | 9 | 18 | 16 | 0 | 0 | 61 |

6.3 Cisco, Yellow Perch, and White Sucker catches by mesh size, Crawling Valley Reservoir 2010

CISC

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 4 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 9 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 1 | 4 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 4 | 0 | 5 | 2 | 2 | 0 | 0 | 0 | 13 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 1 | 0 | 2 | 2 | 0 | 0 | 1 | 1 | 7 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Total | | | | 12 | 1 | 10 | 6 | 5 | 1 | 4 | 2 | 41 |

YLPR

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | | 5 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |

WHSC

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 2 | 7 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 0 | 5 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | | 1 | 0 | 1 | 1 | 0 | 6 | 7 | 2 | 18 |

6.4 Burbot catch by mesh size, Crawling Valley Reservoir 2010

| Set # | Depth (m) (min - max) | Temp (°C) | Soak Time (h) | Mesh Size 25 | 38 | 51 | 63 | 76 | 102 | 127 | 152 | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S7 | (2.9 - 3.9) | 12.0 | 23.3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D10 | (6.2 - 9.9) | 12.0 | 24.0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D5 | (10.0 - 11.0) | 13.0 | 25.1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S2 | (2.0 - 4.5) | 13.0 | 25.2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D6 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| D3 | (13.0 - 13.0) | 12.5 | 26.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D1 | (9.8 - 9.2) | 13.0 | 21.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S8 | (2.0 - 4.0) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| S9 | (1.7 - 2.6) | 13.0 | 22.5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| D16 | (5.0 - 5.0) | 13.0 | 22.8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |

6.5 Statistics of the catch distribution for game fish catches, Crawling Valley Reservoir 2010. This data is for presentation of the statistical nature of the catch distribution and are based on the geometric mean values (unweighted)

| | Walleye | Northern Pike | Cisco | Lake Whitefish | Yellow Perch |
|---|---|---|---|---|---|
| Mean | 28.5 | 6.1 | 4.1 | 1.4 | 0.6 |
| Standard Error | 5.0 | 0.8 | 1.3 | 0.6 | 0.5 |
| Median | 26.5 | 6.5 | 2.5 | 0.5 | 0 |
| Mode | 21 | 4 | 1 | 0 | 0 |
| Standard Deviation | 15.9 | 2.6 | 4.3 | 2 | 1.6 |
| Sample Variance | 253.2 | 6.5 | 18.1 | 3.8 | 2.5 |
| Kurtosis | -0.7 | -1 | 0.7 | 2.7 | 8.9 |
| Skewness | 0.4 | -0.3 | 1.1 | 1.5 | 2.8 |
| Range | 49 | 9 | 14 | 7 | 6 |
| Minimum | 9 | 2 | 0 | 0 | 0 |
| Maximum | 57 | 10 | 13 | 6 | 5 |
| Sum | 285 | 61 | 41 | 14 | 6 |
| Count | 10 | 10 | 10 | 10 | 10 |
| Confidence Interval | 9.9 | 1.6 | 2.6 | 1.2 | 1.0 |